Want to Play?

Trident is ideal for exploring—on a smaller but scientifically useful scale—proton acceleration; laser-plasma interactions (see "Going for the Gold" in Learn more sidebar); small, intense pulsed x-ray sources; and other concepts useful to X-Gamers, says Montgomery. Although larger facilities have more than enough power to pursue such studies, they lack Trident's beam quality and flexibility, which allow Trident to perform some high-energy-density physics experiments not presently possible at larger facilities. Larger facilities are also much more expensive to use. So it's productive and cost effective to explore interesting possibilities at Trident, even if the work eventually moves to another facility.

Trident is no secret in the scientific community. Researchers from around the world bring their experiments to the Los Alamos facility to take advantage of its quality and versatility, the hands-on research that can done there, and the opportunity to interact with Trident's resident scientists. This past summer, 27 proposals were received for access to Trident beam time during the first half of 2009, and more proposals were submitted in October.

So, if you're thinking about the X-Games, David Montgomery could be the guy to call.

Going for the Gold

Lawrence Livermore's National Ignition Facility will be the site of renewed efforts to try for the first time to sustain fusion reactions in the laboratory. If all goes well, the facility's intense laser beams will compress and heat to fusion a mixture of two hydrogen isotopes—deuterium and tritium—contained in a hollow, BB-size sphere of beryllium or plastic.

The beams will compress the fusion fuel indirectly, as shown in the figure below. (A) They will strike the inner walls of a hollow gold cylinder about the size of a pencil eraser, producing a hot gold plasma. (B) The gold plasma will then radiate x-rays that compress the sphere, which will be positioned at the cylinder's center. (C) The compressed and heated fuel will "ignite" to produce sustained fusion reactions. However, earlier experiments with the Nova laser showed the beams might fail to reach the gold walls because of another plasma that the beams will form first by ionizing the sphere supports, the helium gas that surrounds the sphere, and plastic windows at the ends of the cylinder.

The problem is that large periodic density variations, or waves, could develop in the first plasma. Such waves Going for the Goldreflect light, and although small waves are always present in a plasma, laser light can pump energy into them so they grow large enough to reflect all the laser light away from its original path.

Normally, a laser beam contains hundreds of bright points called "speckles" caused by the beam's constituent light waves interfering with each other. (The overlapping of the crests of two waves produces a speckle.) The ideal way to study how a laser beam interacts with a plasma is to first study how one of those speckles interacts with a plasma. Montgomery headed a small team from 1999 to 2007 to do just that. The more-realistic situation was later addressed by applying what was learned for one speckle to the hundreds of speckles in an actual laser beam.

In Montgomery's experiments, one Trident beam produced a single speckle, and a second beam produced a well-characterized plasma.

Before these studies, no one really knew, despite various theories, exactly how laser light can cause plasma waves to grow and how their growth can be stopped. These experiments have provided that understanding.